

REMARKS

By this response, Claim 25 has been amended. Claims 25 and 28-45 are pending in the application. Favorable reconsideration is respectfully requested in view of the following remarks.

Rejection Under 35 U.S.C. § 103

Claims 25 and 28-45 stand rejected under 35 U.S.C. § 103(a) over U.S. Patent No. U.S. Patent No. 5,935,373 to Koshimizu ("Koshimizu") in view of U.S. Patent No. 5,200,373 to Namose ("Namose"). Claim 37 was previously cancelled. The rejection is respectfully traversed.

Claim 25, as amended, recites a gas injector for supplying process gas to a plasma processing chamber wherein a semiconductor substrate is subjected to plasma processing. The gas injector comprises, *inter alia*, gas injector body of dielectric material and sized to extend through a chamber wall of the processing chamber such that a planar axial distal end surface of the gas injector body is exposed within the processing chamber, the gas injector body including a bore and a plurality of gas outlets in fluid communication with the bore, the gas outlets adapted to supply process gas into the processing chamber, wherein the gas outlets are located in the planar axial distal end surface of the gas injector body with the total area of the gas outlets less than the cross-sectional area of the bore and the gas outlets are sized to inject the process gas at a subsonic, sonic or supersonic velocity (emphasis added). Support for the amendment to Claim 25 can be found at page 18, lines 25-26, of the specification.

The combination of Koshimizu and Namose does not suggest the gas injector for supplying process gas to a plasma processing chamber recited in Claim 25.

Koshimizu's plasma processing apparatus shown in Figure 1 comprises a processing vessel 102 including an insulator 108 and a processing gas supply port 156 mounted in the insulator 108. (Column 5, lines 41-45). As shown, the processing gas supply port 156 has only a single gas outlet.

Regarding Claim 25, the Examiner acknowledges that Koshimizu does not teach the following features: (1) a gas injector comprising a body of dielectric material; (2) a plurality of gas outlets adapted to supply process gas into a processing chamber; and (3) gas outlets located in a planar axial distal end surface of a gas injector. (Official Action at page 5, points (i) and (ii)).

However, the Examiner asserts that Namose teaches a semiconductor manufacturing apparatus shown in Figures 1 to 3 including plural, angled outlets 5 (Figures 2 and 3). The Examiner contends that it would have been obvious "to optimize the dimensions of Koshimizu's gas injector outlets as taught by Namose, made from process compliant materials and sealed for hermicity." (Official Action, page 8).

The semiconductor device manufacturing apparatus shown in Figures 1 to 3 of Namose includes an upper electrode 2; a lower electrode 3 on which a wafer 7 is supported; an intermediate electrode 4 between the upper electrode 2 and lower electrode 3 and having through-holes 5; and an optical end point detecting unit 8 and a detecting section 9 for detecting the end point of an etching operation in the reaction chamber. The through-holes 5 in the intermediate electrode 4 are arranged so that optical paths are formed parallel to the straight line connecting a material to

be etched and the detecting section 9 of the optical end point detecting unit 8. (Column 2, lines 49-59). A power source 6 is electrically connected to the lower electrode 3 and intermediate electrode 4.

Neither Koshimizu nor Namose suggests a gas injector body including a bore and a plurality of gas outlets in fluid communication with the bore, where the gas outlets are adapted to supply process gas into a processing chamber, and are located in the planar axial distal end surface of the gas injector body with the total area of the gas outlets less than the cross-sectional area of the bore. Accordingly, the combination of Koshimizu and Namose does not suggest a gas injector comprising every feature in Claim 25.

For at least the above reasons, Claim 25 is patentable over the combination of Koshimizu and Namose. Claims 28-38 and 43-45, which depend from Claim 25, are also patentable over the applied combination of references for at least the same reasons as those for which Claim 25 is patentable. Moreover, these dependent claims recite additional features that provide additional bases for patentably distinguishing the claimed subject matter over the applied references. For example, Claim 28 recites that "the gas outlets include a center gas outlet extending in the axial direction and a plurality of angled gas outlets extending at an acute angle to the axial direction." Neither Koshimizu nor Namose suggests a gas injector comprising a gas injector body including the combination of gas outlets recited in Claim 28.

Koshimizu's processing gas supply port 156 includes only a single, axial gas outlet. Namose's intermediate electrode 4 can include a single angled through-hole 5 as shown in Figure 1, or it can include only angled through-holes 5 with no axial through hole but, as shown in Figures 2 and 3. Accordingly, the combination of

Koshimizu and Namose also does not disclose or suggest every feature recited in Claim 28. Furthermore, in the absence of any disclosure or suggestion in Koshimizu or Namose of the features of Claim 28, the Examiner did not explain why it would have been obvious to modify Koshimizu's processing gas supply port 156 to result in the gas injector recited in Claim 28.

Claim 30 recites the features of "the gas injector includes at least one seal adapted to contact the dielectric window when the gas injector is mounted in the dielectric window" (emphasis added). Claim 32 recites the features of "the gas injector is adapted to be removably mounted in an opening in the chamber wall and includes at least one O-ring providing a vacuum seal between the gas injector and the chamber wall" (emphasis added). Claim 35 recites the features of "the gas injector body includes at least one O-ring seal on an outer surface of the gas injector body" (emphasis added). The Examiner acknowledges that Koshimizu does not disclose the features of Claims 30, 32 and 35. (Final Official Action at pages 5 to 6, points (iv), (vi) and (vii), respectively).

The Examiner alleges that Namose's intermediate electrode is "sealed for hermicity." (Final Official Action at page 8, next-to-last paragraph). However, the Examiner identified no explicit disclosure in Namose that supports this allegation. Namose does not disclose or suggest the features of "at least one seal adapted to contact the dielectric window when the gas injector is mounted in the dielectric window," as recited in Claim 30; or "at least one O-ring seal" recited in Claims 32 and 35.

Claim 36 recites the features of "the gas injector body includes a first O-ring seal on an outer surface of the gas injector body and a second O-ring seal in a

surface of a flange extending from the outer surface of the gas injector body"
(emphasis added).

The Examiner acknowledges that Koshimizu does not teach the features of Claim 36. (Final Official Action at page 6, point (viii)). However, the Examiner also did not identify any explicit disclosure in Namose regarding the features of Claim 36.

Independent Claim 39 is directed to a gas injector for supplying process gas to a plasma processing chamber wherein a semiconductor substrate is subjected to plasma processing. The claimed gas injector comprises, *inter alia*, a gas injector body including a plurality of gas outlets adapted to supply process gas into the processing chamber and a cylindrical bore adapted to supply process gas to the gas outlets, the cylindrical bore being defined by a sidewall and an endwall which extends radially inwardly from the sidewall, the gas outlets including a center gas outlet extending from the endwall in the axial direction and a plurality of angled gas outlets extending from the endwall at an acute angle to the axial direction, wherein the gas outlets are located in the axial distal end surface of the gas injector body; and a first O-ring in the surface of the flange for sealing against the outer surface of the chamber wall (emphasis added).

The Examiner acknowledges that Koshimizu does not disclose or suggest a gas injector comprising a gas injector body including a plurality of gas outlets adapted to supply process gas into the processing chamber and a cylindrical bore adapted to supply process gas to the gas outlets, the cylindrical bore being defined by a sidewall and an endwall which extends radially inwardly from the sidewall, wherein the gas outlets are located in the axial distal end surface of the gas injector body; or that the processing gas supply port 156 includes a first O-ring in a surface

of a flange for sealing against the outer surface of a chamber wall, as recited in Claim 39. (Final Official Action at page 6, point (x)). However, the Examiner alleges that it would have been obvious to "optimize the dimensions of Koshimizu's gas injector outlets as taught by Namose." (Official Action at page 8, next-last-paragraph). Applicants disagree.

Namose does not disclose or suggest the missing features of Koshimizu with respect to the gas injector recited in Claim 39. Namose does not disclose a gas injector for supplying process gas to a plasma processing chamber, much less a gas injector comprising a gas body including a plurality of gas outlets adapted to supply process gas into the processing chamber or a cylindrical bore adapted to supply process gas to the gas outlets. The cylindrical bore recited in Claim 39 is defined by a sidewall and an endwall which extends radially inwardly from the sidewall. Neither Koshimizu nor Namose discloses or suggests a cylindrical bore partially defined by an endwall that extends inwardly from a sidewall. As such, Namose also does not provide any reason to modify Koshimizu's gas supply port 156 to include a cylindrical bore defined by such an endwall, much less to include the features of "a center gas outlet extending from the endwall in the axial direction and a plurality of angled gas outlets extending from the endwall at an acute angle to the axial direction," as recited in Claim 39.

Furthermore, Namose does not suggest "a first O-ring in the surface of the flange for sealing against the outer surface of the chamber wall" (emphasis added), as recited in Claim 39.

Thus, because the combination of Koshimizu and Namose does not include every feature recited in Claim 39 or 40, Claim 39 is patentable over the applied

references. Claim 40, which depends from Claim 39, is also patentable over the applied references for at least the same reasons as those for which Claim 39 is patentable.

Independent Claim 41 is directed to a gas injector for supplying process gas to a plasma processing chamber wherein a semiconductor substrate is subjected to plasma processing. The claimed gas injector comprises, *inter alia*, a gas injector body including a plurality of gas outlets adapted to supply process gas into the processing chamber, wherein the gas outlets are located in the axial distal end surface of the gas injector body, wherein the gas injector body includes a uniform diameter central bore adapted to supply gas to the gas outlets, the central bore extending axially from an upper axial end face of the gas injector body, the central bore being defined by a cylindrical sidewall and a circular, planar endwall extending between the cylindrical sidewall, inlets of the gas outlets being located on the planar endwall" (emphasis added). The Office acknowledges that Koshimizu's gas supply port 156 does not include a plurality of gas outlets adapted to supply process gas into a processing chamber, wherein the gas outlets are located in an axial distal end surface of the gas injector. (Final Official Action at page 7, point (xii)). Namose does not disclose or suggest the missing features of Koshimizu with respect to Claim 41.

As discussed above, Namose does not disclose or suggest a gas injector comprising the features of a central bore being defined by a cylindrical sidewall and a circular, planar endwall extending between the cylindrical sidewall, much less having inlets of the gas outlets located on the planar endwall, as recited in Claim 41.

Thus, because the combination of Koshimizu and Namose does not include every feature recited in Claim 41, Claim 41 is patentable over the applied references.

Independent Claim 42 recites a gas injector for supplying process gas to a plasma processing chamber wherein a semiconductor substrate is subjected to plasma processing. The gas injector comprises, *inter alia*, a gas injector body made of a dielectric material selected from the group consisting of quartz, alumina and silicon nitride, the gas injector body including a plurality of gas outlets adapted to supply process gas into the processing chamber, wherein the gas outlets are located in the planar axial distal end surface of the gas injector body. The Examiner acknowledges that Koshimizu does not teach these features. Namose fails to disclose or suggest the missing features of Koshimizu with respect to Claim 42.

As discussed above, Namose does not disclose or suggest a gas injector comprising a body made of a dielectric material, much less the dielectric materials recited in Claim 42. In contrast, Namose discloses an intermediate electrode 4, which one skilled in the art would understand to be an electrical conductor.

Additionally, Koshimizu and Namose both fail to disclose or suggest a gas injector comprising a body including an axial distal end surface including a plurality of gas outlets, as recited in Claim 42.

Thus, because the combination of Koshimizu and Namose does not include every feature recited in Claim 42, and the Examiner has merely made conclusory statements without some articulated reasoning with some rational underpinning to support the alleged obviousness, Claim 42 is patentable.

Therefore, withdrawal of the rejection is respectfully requested.

Conclusion

For the foregoing reasons, allowance of the application is respectfully requested. If there are any questions concerning this response, the Examiner is respectfully requested to contact the undersigned at the number given below.

Respectfully submitted,

BUCHANAN INGERSOLL & ROONEY PC

Date: February 6, 2008

By: _____



Peter K. Skiff
Registration No. 31917

P.O. Box 1404
Alexandria, Virginia 22313-1404
(703) 836-6620